

REMARKS

In the Action, claims 1, 2 and 4-15 are rejected. In response, the claims are canceled and replaced with new claims 16-44. The pending claims in this application are claims 16-44, with claims 16, 26, 30, 31, 40 and 44 being independent.

Independent claims 16, 26 and 30 correspond substantially to original claims 1, 8 and 15. As rewritten, these claims recite the process for producing the water-absorbent resin where the acrylic acid and/or its salt are produced by a process comprising the steps of obtaining acrylic acid by catalytic gas-phase oxidation of propylene and/or propane and reducing the aldehyde impurity content of the acrylic acid to not more than 10 ppm. Claims 16 and 24 further recite the step of treating the purified acrylic acid with an alkali treatment where the alkali solution contains 0.5 to 20 ppm of oxygen. Claim 30 recites the additional step of distilling the acrylic acid in the presence of a hydrazine compound to obtain the acrylic acid having a protoanemonin content of not more than 10 ppm. Claims 17-23 depend from claim 16 and correspond to original claims 2, 4-7, 11 and 12, respectively. Claims 24 and 25 depend from claim 16 to recite the water-absorbent resin produced by the claimed process. Claims 27-29 depend from claim 16 and correspond to original claims 9, 10 and 14, respectively.

Claims 31-44 are directed to a water-absorbent resin produced by the process as recited in claims 16, 26 and 30 and the claims depending therefrom. The features of these claims correspond substantially to claims 16-30.

Since the pending claims correspond substantially to the original claims, the claims are fully supported by the specification as originally filed. In view of these amendments and the following comments, reconsideration and allowance are requested.

Claims 4 and 8 are objected to on matters of form. Initially, it is noted that the objection to claim 4 was corrected in the previous Amendment. Furthermore, claims 4 and 8 are canceled

by this Amendment, and replaced with new claims. The new claims are submitted to overcome these objections.

Rejections Under 35 U.S.C. § 103

In the Action, claims 1-3, 5-9, 13 and 14 are rejected under 35 U.S.C. § 103 as being obvious over U.S. Patent No. 6,444,744 to Fujimaru et al. in view of U.S. Patent No. 5,380,808 to Sumiya et al. Initially, it is noted that claim 3 was canceled by the previous Amendment. Thus, it appears the rejection intended to refer to claims 1, 2, 5-9, 13 and 14.

Fujimaru et al. is cited for allegedly disclosing each of the claimed steps such that the features of the claims are inherent in the process of Fujimaru et al. Sumiya et al. is cited for disclosing a process for producing a water-absorbent resin where the oxygen content of the polymerization solution is reduced to 1 ppm.

The present invention is directed to a process for producing a water-absorbent resin and to the water-absorbent resin obtained by the process. Claim 16 clarifies the process of the invention by reciting the step of producing the acrylic acid by the catalytic gas-phase oxidation of propylene and/or propane such that the resulting acrylic acid contains impurities including protoanemonin. Claim 16 further recites the step of reducing the protoanemonin content of the resulting acrylic acid to not more than 10 ppm, and thereafter subjecting the acrylic acid to a strong alkali treatment in a solution containing 0.5 to 20 ppm. The cited art does not disclose or suggest the claimed process or the product obtained by the claimed process.

The present invention is directed to the discovery that the protoanemonin and furfural content in the acrylic acid monomer component produce a negative influence on the properties of the resulting water-absorbent resin. In particular, Applicants have discovered that while various impurities and byproducts contained in the acrylic acid, the protoanemonin and furfural content have specific disadvantages when they are present in the acrylic acid monomer

component. The water-absorbent resin obtained from an acrylic acid monomer component containing a large amount of protoanemonin and/or furfural exhibits a very high residual monomer content and has a high water extractable content. These features are not disclosed or suggested in the art of record.

One important feature of the claimed invention is the process step to reduce the protoanemonin and/or furfural content within the claimed range to provide the water-absorbent resin with the desired properties. As noted in the Action, Fujimaru et al. does not disclose or suggest producing an acrylic acid monomer component containing the protoanemonin and/or furfural content within the claimed range. Moreover, Fujimaru et al. is specifically directed to a process for purifying the monomer component to reduce the hydroquinone content which was added as a polymerization inhibitor. Thus, Fujimaru et al. is concerned only with removing the hydroquinone and has tailored the process to ensure that the hydroquinone is removed. Fujimaru et al. does not recognize that the protoanemonin and/or furfural content can or should be reduced and thus provides no motivation or incentive to one of ordinary skill in the art to modify the process to attain the claimed results.

Fujimaru et al. is concerned with reducing the yellowness index of the resulting water-absorbent resin and has found that the yellowness index can be lowered by removing the hydroquinone. Fujimaru et al. is not concerned with reducing the amounts of residual monomer or reducing the water-extractable content of the resulting water-absorbent resin. Furthermore, Fujimaru et al. provides no suggestion that the disclosed process lowers the amount of residual monomer and lowers the water-extractable content of the resulting water-absorbent resin. Therefore, Fujimaru et al. provides no motivation or incentive to one of ordinary skill in the art to reduce the protoanemonin and/or furfural content of the acrylic acid to obtain a water-absorbent resin having a lower residual monomer content and a low water-extractable content. There is no suggestion in Fujimaru et al. that the process which is intended to reduce the

hydroquinone content is capable of effectively lowering the protoanemonin and/or furfural content of the acrylic acid monomer.

Claim 16 also recites the step of treating the acrylic acid after the protoanemonin content is reduced to not more than 10 ppm by subjecting at least 50 mol% of the acrylic acid to an alkali treatment in a solution containing 0.5 to 20 ppm of oxygen. This step in combination with the step of removing the protoanemonin from the acrylic acid is not disclosed or suggested in the art of record. In particular, Fujimaru et al. does not suggest treating the acrylic acid having a protoanemonin content of not more than 10 ppm with a strong alkali as claimed. As disclosed on page 12 of the specification, the treatment with the alkali provides improved polymerization of the acrylic acid. Furthermore, the alkali treatment in the presence of oxygen in the claimed amount provides a stable system for the monomer. Specifically, the alkali treatment is disclosed on page 12 of the specification as being carried out under an oxygen or air atmosphere. The stable environment for the acrylic acid is provided by an oxygen content in the range of 0.5 to 20 ppm, favorably 1 to 15 ppm, and still more favorably 1.5 to 10 ppm.

The Action appears to suggest that Fujimaru et al. inherently carries out the neutralization step in the presence of oxygen in the claimed amounts. However, the Action specifically notes that Fujimaru et al. discloses purging the reaction vessel with nitrogen to thereby reduce or remove the oxygen from the acrylic acid solution. Thus, contrary to the suggestion in the Action, Fujimaru et al. does not expressly or inherently disclose treating the acrylic acid solution having an oxygen content within the claimed range.

The Action refers to the Examples of Fujimaru et al. in connection with the claimed oxygen content. However, Fujimaru et al. specifically purges the acrylic acid solution with an inert atmosphere such as nitrogen gas. Moreover, Fujimaru et al. specifically purges the atmosphere to reduce and/or remove the oxygen from the solution of the acrylic acid. The claimed invention recites the oxygen content in the range of 0.5 to 20 ppm, such that the 0.5

ppm is the lower limit of the claimed oxygen content. The specification discloses that the oxygen content during the alkali treatment is important to the stability of the acrylic acid. In contrast, Fujimaru et al. suggests that purging the acrylic acid solution to reduce the oxygen content as much as possible provides better results. Thus, Fujimaru et al. provides no motivation or incentive to carry out the alkali treatment where the solution has the claimed oxygen content.

The Action refers to Sumiya et al. for disclosing a process of polymerizing neutralized acrylic acid where the polymerization solution contains 1 ppm of oxygen. The claimed invention recites the oxygen content during the alkali treatment and not during the polymerization step. Sumiya et al. clearly fails to disclose or suggest that the oxygen content during an alkali treatment of the acrylic acid is important to the resulting water-absorbent resin. Thus, Sumiya et al. provides no motivation or incentive to modify Fujimaru et al. to carry out the alkali treatment step in a solution having the claimed oxygen content. At best, Sumiya et al. would suggest polymerizing the monomer component at a certain oxygen concentration.

As noted above, Fujimaru et al. is directed to a process for removing hydroquinone and benzoquinone which were added as polymerization inhibitors. The physical and chemical properties of the hydroquinone and benzoquinone are different from the properties of a protoanemonin and/or furfural such that there is no basis for the position in the Action that the treated acrylic acid of Fujimaru et al. inherently has a protoanemonin and/or furfural content within the claimed range. Fujimaru et al. is only concerned with removing the benzoquinone and hydroquinone prior to the polymerization step and selectively modifies the process to remove these polymerization inhibitors. Therefore, Fujimaru et al. provides no motivation or incentive to remove the protoanemonin and/or furfural content of an acrylic acid monomer component. Fujimaru et al. does not suggest distilling the acrylic acid or otherwise purifying the acrylic acid except when the hydroquinone or benzoquinone are added.

In view of the above comments, independent claim 16 is allowable over the combination of Fujimaru et al. and Sumiya et al. Fujimaru et al. and Sumiya et al. also fail to disclose the furfural content of claim 17, the alkali treatment of claim 18, the polymerization and crosslinking steps of claims 19 and 20, the aldehyde treating agents of claims 21 and 22, in combination with the process steps of claim 16. Fujimaru et al. and Sumiya et al. also fail to disclose a water-absorbent resin produced according to the process of claim 16 and having a water absorption capacity of not less than 25 g/g under load as in claim 23, or the water-absorbent resin of claims 24 and 25. Accordingly, claims 16-25 are allowable over the combination of Fujimaru et al. and Sumiya et al.

Independent claim 26 is also allowable over the art of record for the reasons discussed above in connection with claim 16. Claim 26 is directed to a process for producing a water-absorbent resin from an acrylic acid where the acrylic acid has a protoanemonin content of not more than 10 ppm and is produced by the catalytic gas-phase oxidation of propylene and/or propane, and thereafter subjecting the acrylic acid to a strong alkali treatment in a solution having an oxygen content of 0.5 to 20 ppm. Fujimaru et al. and Sumiya et al. also fail to disclose the strong alkali treatment of claims 27 and 28, and the step of reducing the protoanemonin content to not more than 10 ppm, followed by the strong alkali treatment as in claim 29 in combination with the process steps of claim 26. Accordingly, claims 26-29 are allowable.

Independent claim 30 is directed to a process for producing a water-absorbent resin having a neutralization of not less than 50 mol% and obtained by polymerizing an acrylic acid monomer component where the acrylic acid has a protoanemonin content of not more than 10 ppm and is obtained by the catalytic gas-phase oxidation of propylene and/or propane followed by distilling the acrylic acid in the presence of a hydrazine compound to obtain the acrylic acid having a protoanemonin content of not more than 10 ppm. For the reasons discussed above,

Fujimaru et al. and Sumiya et al. do not disclose or suggest the claimed process steps so that claim 30 is allowable over the combination of Fujimaru et al. and Sumiya et al.

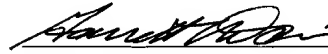
Claims 11 and 12 are rejected as being obvious over Fujimaru et al. in view of Sumiya et al. and further in view of U.S. Patent No. 3,725,208 to Maezawa et al. or Japanese Patent No. 9-316027 or British Patent 2,285,046. The secondary references are cited for disclosing the use of a hydrazine compound. The Action contends that it would be obvious to use a hydrazine compound in the process of Fujimaru et al.

Maezawa et al., JP 9-316027 and British Patent 2,285,046 clearly do not disclose or suggest that the protoanemonin content can be removed or that a hydrazine compound can be used to lower the protoanemonin content of acrylic acid. As discussed above, the claims are specifically directed to a process for removing or reducing the protoanemonin content to an amount of not more than 10 ppm. Since the secondary references provide no suggestion that a hydrazine compound can be used to reduce the protoanemonin content, these references provide no motivation or incentive to one of ordinary skill in the art to modify the process of Fujimaru et al. Furthermore, even if one were to combine the cited patents in the manner suggested in the Action, one skilled in the art would have no expectation of success in lowering the protoanemonin content of the acrylic acid. The aldehyde-treating agent and the hydrazine compound are now recited in claims 21, 22 and 30. Accordingly, these claims are not obvious over the combination of the cited patents.

New claims 31-34 are directed to the resulting water-absorbent resin obtained by the process of claims 16, 26 and 30. For the reasons discussed above, the cited art does not disclose or suggest the claimed process steps for obtaining the acrylic acid having a protoanemonin content within the claimed range and polymerizing the resulting acrylic acid to obtain the water-absorbent resin. Accordingly, claims 31-44 are allowable over the art of record.

In view of these amendments and the above comments, reconsideration and allowance are requested.

Respectfully submitted,



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